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Deformation offshore Northern Chile monitored by a seafloor geodetic network (GeoSEA)

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The Nazca-South American plate boundary around 21°S has last ruptured in an earthquake in 1877 and was identified as a seismic gap prior to the 2014 Iquique earthquake (Mw=8.1). The southern portion of this segment is still unbroken. The geodetic monitoring of the Chilean subduction zone is crucial to understand the deformation processes in this area. Most geodetic measurements rely on GPS and are therefore limited to onshore campaigns. In December 2015, we installed the GeoSEA (Geodetic Earthquake Observatory on the SEAfloor) array around 21°S of the Nazca-South American plate boundary with RV SONNE to extend the geodetic observations to the offshore areas. The GeoSEA array consists of autonomous acoustic seafloor transponders mounted on 4 m high tripods. These transponders are able to continuously measure the two-way travel time of acoustic signals between station pairs (baselines) and the properties of the sea water (sound speed, temperature and pressure) at each transponder. These measurements are used to retrieve the distances between the transponders and give insights into the deformation of the seafloor. At the Chilean subduction zone, we installed in total 23 transponders in 3 subarrays with interstation distances of up to 2500 m. On the middle continental slope in 2300 m water depth, an array consisting of 8 transponders measures across crustal faults seen in AUV mapping. A second array of 5 stations located on the outer rise monitors extension across normal plate-bending faults. The deepest deployment in ∼5000 m water depth located on the lower continental slope with 10 stations is designed to measure diffuse strain build-up. The transponders are intended to monitor the seafloor deformation for 3.5 years. In November 2016 during a cruise of RV Langseth, the first 11 months of data were successfully uploaded via an acoustic modem. Furthermore, an additional component of the network, GeoSURF, a self-steering autonomous vehicle (wave glider), was successfully used to monitor system health and to upload parts of the data from the seafloor stations. The first 11 months of data show a good signal quality and the baseline precision is ± 5 mm. The data reveals no deformation above the resolution limits of the individual distance measurements.